INAUGURATION

PRESIDENT CHARLES SUMNER HOWE
CASE SCHOOL OF APPLIED SCIENCE

MAY 10 AND 11 1904

Jan 13

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THE IMPERIAL PRESS CLEVELAND

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Case Institute of Technology Cleveland.

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PRESIDENT CHARLES SUMNER HOWE
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CLEVELAND

MAY 10 AND 11 1904

PROGRAM OF THE EXERCISES

CLEVELAND OHIO
1904

CASE SCHOOL OF APPLIED SCIENCE

Founded by Leonard Case, February 24, 1877

Chartered, April 7, 1880

Opened for Instruction, September 15, 1881

PRESIDENTS

Cady Staley, 1886–1902

Charles Sumner Howe, *acting*, 1902–1903

Charles Sumner Howe, 1903–

TUESDAY, MAY THE TENTH

In the evening, at eight o'clock, an Informal Reception will be given to the Delegates at The University Club, 692 Prospect Street

WEDNESDAY, MAY THE ELEVENTH

At half past nine the Procession will form at the Main Building of Case School of Applied Science and move to the Euclid Avenue Congregational Church, where the Inauguration Exercises will be held

ORDER OF THE PROCESSION

Professor Frank Robertson Van Horn
Chief Marshal

FIRST DIVISION

Stanton Irving Charlesworth, '04, Marshal

The Undergraduates of Case School of Applied Science

Senior Class, Albert Collinwood Hawley, Marshal
Junior Class, Dwight Backus Ball, Marshal
Sophomore Class, Hugh Davidson Pallister, Marshal
Freshman Class, George Skinner Vail, Marshal

SECOND DIVISION

Professor Theodore M. Focke, Marshal

The Trustees and The Faculty of Case School of Applied Science
The Speakers at the Exercises

THIRD DIVISION

Professor Richard Gustavus Dukes, Marshal

The Delegates and Official Guests

FOURTH DIVISION

Mr. Robert Hoffman, Class of 1893, Marshal

The Alumni of Case School of Applied Science

WEDNESDAY, MAY THE ELEVENTH

ORDER OF THE INAUGURATION EXERCISES

President John M. Henderson of the Board of Trustees
Presiding

Processional, Inaugural March. *Clarke*
Organ and Philharmonic Quartette.

Music, Andante Cantabile. *Tschaikowsky*
Philharmonic Quartette.

Invocation.
By President Henry Churchill King
of Oberlin College.

Address on behalf of the Trustees.
By Mr. Worcester Reed Warner.

Response.
By President Howe.

Music, Theme and Variations. *Beethoven*
Philharmonic Quartette.

Address on behalf of the Universities.
By President Ira Remsen
of Johns Hopkins University.

Address on behalf of the Technical Schools.
By President Henry Smith Pritchett
of The Massachusetts Institute of Technology.

Address on behalf of the Technical Societies.
By Mr. John R. Freeman
of The American Society of Mechanical Engineers.

Address on behalf of the Colleges of Ohio.
By President Charles Franklin Thwing
of The Western Reserve University.

Music, Hungarian Dance. *Hoffman*
Philharmonic Quartette.

WEDNESDAY, MAY THE ELEVENTH

Inaugural Address, "Does a Technical Course Educate?"

By President Charles Sumner Howe.

Song, "Messkunst." (Tune: Lauriger Horatius.) *Staley*

By the Students of Case School of Applied Science.

"O Messkunst, Zaum der Phantasie,
Wer dir will folgen irret nie."
Results precise our aim shall be,
We keep our work from error free.

Chorus: S - C - I - E - N - C - E.

Ever let your motto be,
O Messkunst, Zaum der Phantasie,
Wer dir will folgen irret nie.
O'er hill and dale our lines we trace,
Each curve and tangent in its place.
Our ref'rence marks upon Earth's face,
Or points of light in endless space.

Chorus: S - C - I - E - N - C - E, etc.

We measure force as well as lines;
Electric currents; wealth of mines;
How bright the flame in splendor shines;
How atom with its mate combines.

Chorus: S - C - I - E - N - C - E, etc.

Benediction.

By the Reverend Caspar Wistar Hiatt
of the Euclid Avenue Congregational Church.

Recessional, March from Athalia. *Mendelssohn*

Organ and Philharmonic Quartette.

. . . .

The Audience will please remain in place until the procession has left the church.

WEDNESDAY, MAY THE ELEVENTH

At one o'clock a luncheon will be served to the Delegates from other Institutions, and the Trustees, Faculty and Alumni of Case School of Applied Science, in the Parlors of the Church. (Admission by card.)

From three to five o'clock the Laboratories and Shops of Case School of Applied Science will be open for the inspection of Delegates and friends of the Institution. Instructors will be in attendance at the President's office to conduct guests and explain points of interest.

At three o'clock there will be a game of baseball between Case and Adelbert on Case Field.

At seven o'clock the Inauguration Banquet to the Delegates, Invited Guests, Trustees and Faculty, will be given at the Hollenden. (Admission by card.)

At half past eight o'clock an informal dance will be given in the Main Building to the Undergraduates, former Students and Alumni of Case School of Applied Science.

LIST OF DELEGATES

DELEGATES FROM INSTITUTIONS

Harvard University
Frederick Adrian Delano, A. B.

Yale University
Sheffield Scientific School
Professor Charles Brinkerhoff Richards, M. A.

University of Pennsylvania
Professor Charles Leander Doolittle, C.E., Sc. D.

Columbia University
The Schools of Applied Science
Dean Frederick Remsen Hutton, E. M., Ph. D.

Dartmouth College
President William Jewett Tucker, D.D., LL. D.

Western University of Pennsylvania
Ex-Chancellor John A. Brashear, Sc. D., LL. D.

University of Tennessee
President Charles William Dabney, Ph. D., LL. D.

Union College
Professor Olin Henry Landreth, A. M., C. E.

United States Military Academy
Brigadier General George Armstrong Garretson, U. S. V.

Miami University
President Guy Potter Benton, A. M., D. D.

Kenyon College
President William Foster Pierce, A.M., L. H. D.

Western Reserve University
President Charles Franklin Thwing, D.D., LL.D.
Adelbert College
Prof. Edward Williams Morley, M. D., Ph. D., LL. D.
The College for Women
Professor Frank Perkins Whitman, A. M., D. Sc.
The Dental College
Dean Henry Lovejoy Ambler, M.S., D.D.S., M.D.
The Medical College
Professor Torald Sollman, M. D.

University of Toronto
Ontario School of Practical Science
Mr. Virgil G. Marani, C. E.

McGill University
Schools of Applied Science
Professor C. H. McLeod, Ma. E., F. R. S. C.

St. Louis University
Professor Frederick L. Odenbach, S. J.

Denison University
Professor John Lord Gilpatrick, A. M., Ph. D.

Oberlin College
President Henry Churchill King, A. M., D. D.
Professor Charles Edward St. John, Ph. D.

Marietta College
President Alfred Tyler Perry, M. A., D. D.

Alfred University
Pres. Booth Colwell Davis, A. M., Ph. D., D. D.
Captain Russell E. Burdick.

Mount Holyoke College
President Mary Evans, A. M., LL. D., of Lake Erie College.

University of Michigan
President James Burrill Angell, LL. D.

University of Missouri
President Richard Henry Jesse, LL. D.

Baldwin University
Professor E. L. Fulmer, M. S.

Wittenberg College
Professor Alvin Frank Linn, A. M., Ph. D.

Bucknell University
President John Howard Harris, Ph. D., LL. D.

Mt. Union College
President Albert Burdsall Ricker, A. M., D. D.
Professor Benjamin Franklin Yanney, A. M.

Otterbein University
Professor Louis H. McFadden, A. M.

University of Wisconsin
President Charles Richard Van Hise, M. S., Ph. D.

College of Mechanics and Engineering
Dean Frederick Eugene Turneaure, C. E.

Geneva College
President William Pollock Johnston, A. M., D. D.

University of Rochester
Charles B. Parker, M. D.

Hiram College
Acting Pres. Edmund Burritt Wakefield, A. M.
Professor George Henry Coulton, M. S., Ph. D.

Northwestern University
Pres. Edmund Janes James, Ph. D., D. D., LL. D.

Washington University
Chancellor Winfield Scott Chaplin, A. M., LL. D.

Lake Erie College
President Mary Evans, A. M., LL. D.
Dean Luette P. Bentley.

Wheaton College
President Charles A. Blanchard, D. D.

Massachusetts Institute of Technology
President Henry Smith Pritchett, Ph. D., LL. D.

Lebanon Valley College
President Hervin Ulysses Roop, A. M., Ph. D.

Whitman College
Professor Helen A. Pepoon, Ph. B., B. L.

Carleton College
Mr. James F. Jackson, B. S.

University of Illinois
College of Engineering
Dean Nathan Clifford Ricker, D. Arch.

University of Wooster
Professor William Zebina Bennet, A. M., Ph. D.

University of California

President Benjamin Ide Wheeler, Ph. D., LL. D.

The Engineering Colleges

Professor Arthur Starr Eakle, Ph. D.

Iowa State College

President Albert Boynton Storms, A. M., D. D.

Ohio State University

President William Oxley Thompson, D.D., LL. D.

College of Engineering

Dean Edward Orton, Jr., E. M.

Syracuse University

College of Applied Science

Dean William Kent, A. M., M. E.

Stevens Institute of Technology

Mr. Edward Parkinson Roberts, M. E.

University of Cincinnati

President Howard Ayers, Ph. D., LL. D.

College of Engineering

Professor Christian William Marx, B. E.

Buchtel College

President A. B. Church, A. M., D. D.
Professor Carl F. Kolbe, A. M., Ph. D.
Professor Maria Parsons, A. M.
Professor Charles M. Knight, A. M., Sc. D.

Purdue University

President Winthrop Ellsworth Stone, Ph. D.

Rose Polytechnic Institute

President Carl Leo Mees, Ph. D.

Hebrew Union College

Rabbi Moses J. Gries, B. L.

Johns Hopkins University

President Ira Remsen, M. D., Ph. D., LL. D.

Brigham Young College

President James H. Linford, D. B., B. S.

Carnegie Technical Schools
Trustee John A. Brashear, Sc. D., LL. D.
Director Arthur A. Hamerschlag.

United States Naval Observatory
Professor Aaron Nichols Skinner, U. S. N.

United States Weather Bureau
Professor Cleveland Abbe, Ph. D., LL. D.

Lick Observatory
Mr. Ambrose Swasey.

FROM SCIENTIFIC ASSOCIATIONS

American Association for the Advancement of Science
President Henry Smith Pritchett, Ph. D., LL. D.

American Chemical Society
Professor Albert Benjamin Prescott, M.D., LL.D.

American Institute of Electrical Engineers
President Bion Joseph Arnold, M. S., M. Ph., E. E.

American Mathematical Society
Professor Clarence Abiathar Waldo, Ph. D.

American Society of Mechanical Engineers
Mr. Ambrose Swasey.
Mr. John R. Freeman.

Association of Engineering Societies
Mr. John R. Freeman.

Astronomical and Astrophysical Society
Professor Charles Leander Doolittle, C. E., Sc. D.
Professor Edward Williams Morley, M. D., LL. D.

Civil Engineers' Club of Cleveland
Mr. Ambrose Swasey.

Cleveland Architectural Club
Mr. William G. Watterson.

Cleveland Chemical Society
Professor Hyppolite Gruener, Ph. D.

Electric Club of Cleveland
Mr. Charles William Wason.

Electro-Chemical Society
Mr. Alfred H. Cowles.

Montana Society of Engineers
Mr. Charles Metlicka.

Royal Astronomical Society
Professor Ernest William Brown, M. A., Sc. D.

Western Society of Civil Engineers
Past President H. E. Horton, C. E.

American Chemical Society
Professor William McPherson, M. Sc., Ph. D.

FROM SCIENTIFIC JOURNALS

Electrical World and Engineer
Mr. George S. Davis.

Engineering News
Mr. F. E. Schmitt.

Engineering Record
Mr. George S. Davis.

INAUGURATION COMMITTEES

FOR THE TRUSTEES

Mr. Worcester Reed Warner
Mr. Eckstein Case

FOR THE FACULTY

Professor Charles H. Benjamin
Professor Charles Frederick Mabery
Professor Frank Mason Comstock
Professor John Williams Langley
Professor Arthur Silas Wright

ADDRESS ON BEHALF OF THE TRUSTEES

BY MR. WORCESTER REED WARNER

Mr. Chairman, Guests of Case School, Ladies and Gentlemen:

On behalf of the Trustees of Case School of Applied Science, it is my privilege to welcome you on this occasion.

The work of the Institution began twenty-three years ago, and has been carried on so quietly and modestly, in accordance with the character and disposition of the Founder, that a few facts relative to it may be of interest even to Cleveland citizens here this morning.

Leonard Case, Jr., the Founder of this Institution, died in 1880, at the age of 60 years. He did not bequeath his property for the endowment of this school, but conveyed it by deeds of trust while he was himself able to formulate the general plan to be carried out by the Trustees. The year following his death the School was opened, with six professors and sixteen students, in the Case homestead, and continued there till 1885, when the new building was ready for it on the Campus donated by generous citizens.

Eighteen eighty-five was also notable by reason of the fact that in May of that year Mrs. Laura Kerr Axtel, of Painesville, deeded to the School, lands, the sale of which has realized over $200,000. This gift was supplemented by a bequest of $60,000, made known at the time of her death, in 1890.

The growth and progress of the School have developed a continual need of new halls and laboratories. Two of these were completed in 1892, for the departments of Chemistry and Mechanical Engineering, respectively. These were followed in 1896 by the Electrical Laboratory. Such an equipment would seem adequate to the progress of any ordinary College, but Case School of Applied Science is not in that class, for the Department of Physics and the Department of Mining Engineering have for a long time been knocking at the Trustees'

door, and when it was slightly held ajar they have pleadingly told their needs.

It has been the policy of the Trustees, however, to defer building laboratories until the money to pay for them was provided. We have tried to have the business administration conducted on a business basis, and yet I fear that a single illustration of our financial management will lose us your commendation; still I will venture to mention it. During the year just closing for every dollar received from the students in payment for tuition, there has been re-expended for them three dollars. Do you consider this a good investment? We do; for it is qualifying young men to go out well equipped to do the world's best scientific work.

In 1885, Cady Staley, Ph. D., was chosen the first President of Case School of Applied Science. Though never inaugurated, for sixteen years he remained the able head of the Institution, during which time its growth was remarkable, for at the time of his resignation in 1902, the faculty numbered 22 and the student body 353.

Selecting a College President is a work of no small responsibility. The Trustees' Committee looked far and wide and received from interested friends the scholastic and executive record of a score of available men, but all the time they kept in mind the Secretary of the Faculty, who was guiding the affairs of the College at home.

One of the Committee remarked in my hearing that, "If we had secured a new President a year ago who had managed the College as well as the Secretary of the Faculty has conducted it, should we not have considered our choice singularly fortunate?" We decided this question in the affirmative, and then unanimously elected Charles Sumner Howe, to the Presidency of Case School of Applied Science.

His administration begins under most favorable auspices, with a faculty of 30 earnest co-workers, a student body of more than 450 able, ambitious young men, and conditions of peculiar promise.

For it now becomes my further and very pleasant duty to

announce that there are to be immediately added to Case School certain facilities for which, as has been said, there has been pressing demand, and which will add enormously to its working power and its proper equipment as an institution of technical learning.

A Laboratory of Physics and a Laboratory of Mining Engineering are now being designed, and we expect to break ground for them in the early summer, and have them ready for use in September, one year and four months hence.

The need of these buildings and their equipment was made known to a public-spirited citizen, who requested us to secure reliable estimates of their cost and report to him. Careful investigation made by President Howe and the architects showed that the two laboratories could be built and equipped for the sum of one hundred and eighty-five thousand dollars. It was so reported. In a few days President Howe received the announcement of an unconditional gift, from Mr. John D. Rockefeller, of two hundred thousand dollars for the purpose specified.

President Howe, instead of formally presenting you a bunch of keys and a copy of the Charter, in the name of the Trustees of Case School of Applied Science, I hand over to you the government of this institution of learning.

With so much both of promise and fulfillment at the outset, the Trustees yet pledge you their unabated efforts for the future, and bid you hearty welcome to that position of authority to which it has been their pleasure to elect you in the certain assurance that you will faithfully maintain and steadily advance the honor and prestige of Case School of Applied Science.

RESPONSE BY PRESIDENT HOWE

Gentlemen of the Board of Trustees: With a deep sense of the honor you have conferred upon me and with some knowledge of the duties and responsibilities of the position, I accept the office to which you have elected me and will do all in my power to promote the welfare of Case School of Applied Science.

ADDRESS ON BEHALF OF THE UNIVERSITIES

BY PRESIDENT IRA REMSEN OF JOHNS HOPKINS UNIVERSITY

Mr. President, Mr. Chairman, Ladies and Gentlemen:

I bring from the Johns Hopkins University cordial greetings and hearty congratulations. Perhaps these greetings are a little more cordial for the reason that we claim a certain relationship to the gentleman who is made President of the Case School of Applied Science today. I do not know exactly what the relationship is, but whatever it is we claim it. I don't know that we can call him our son—I don't like to call him our stepson, but I repeat, he is related to us, and we claim that relationship.

The task which has been assigned to me, as you observe, is to give an address on behalf of the universities. It may interest you to know that I was not originally selected to give this address. I will not, however, go into secrets. Possibly some of you are familiar with this particular secret, especially as a preliminary program was printed with another name in place of mine, and I have that program in my pocket. I know that if the gentleman whose name was in the place of mine originally were before you you would get a very good address.

The task which has been assigned to me is not a simple one—but that is a hackneyed phrase. I am to give an address, a brief one, I assure you, on behalf of the universities. That raises the question, What is a University? The answer may be given in terms something like those of the well known answer to the question "Is life worth living?" You remember the famous answer that was given to that question was "It depends upon the liver." (Laughter.) In somewhat the same way I can answer the question "What is a university?" It depends upon the university. For universities differ among one another in glory very markedly. It is a geographical question.

The meaning of the word depends upon where you live, what kind of a university you are connected with. The term university covers a multitude of—forms of activity (laughter), generally supposed to be intellectual, and to some extent they no doubt are. Still, whatever a university may be, I suppose that the word conveys some general idea in regard to the nature of the institution to which it is applied. I think that possibly the nearest we can get to the truth is this, that it stands for research in a very definite way, for investigation into nature and into everything else—research, investigation, an effort to find out the truth, whatever it may be, in whatever direction one may be looking or working. And that, without reference to any practical application or any application whatever that may be made of the results of such investigations. I take that to be the basis for the existence of a university, the reason for its being. A university is a place in which the methods and spirit of investigation are taught and inculcated.

Now, if that is correct, then plainly there is primarily some difference between a university and a school of applied science, of which we have such a conspicuous example in the school whose guests we are today. I do not, however, wish to emphasize that difference. I call attention to it merely for the sake of pointing out what I believe to be a tendency of the present time. That is a tendency to obliterate the difference that originally existed, and still exists to some extent, between the work of a university and the work of a school of applied science. It has been said, you know, that a university is a place where nothing useful is taught. Well, I am willing to stand by that definition, however damaging it may appear. But I claim the right to define the word useful. That is the crux of the matter. On the other hand, generally speaking, everything taught in a school of applied science is useful. The work is directly useful. It affects our daily lives at every turn, and the main object is to teach those things, to develop those subjects, that are directly useful in the occupations in which mankind is generally engaged.

If, now, I have correctly characterized the tendencies of the

university on the one hand and of the school of applied science on the other, how is it possible for them ever to come together? We find that in Germany technical work is being done in universities where a quarter of a century ago it would not have been countenanced. More and more universities are taking up that kind of work, and if we can venture to look far enough into the future we can almost see the time when the university and the technical school—the university with its useless work, or work that is not useful in the ordinary sense, and the school of applied science or the polytechnic with its useful work—will come very near to being identical. They may be said to be running parallel at present. Whether parallel lines are what they used to be in the days of my youth I am not quite sure. I have some suspicion that I have heard from a distinguished mathematician that they are not. That is to say, the simple definition, that which really seems to mean something to most of us—that parallel lines are two lines that never meet no matter how far they extend, is not true. They go out into infinity and perhaps they meet there, and then they come back again. We need not bother about that, for the figure ceases to work at that point. The meeting is the important thing. Whether there is some such relation between the school of applied science and the university I cannot tell. Whether they will ever meet it is impossible for us to say. But they are tending together.

The tendency to which I refer is a real one, and it is due, I think, to two causes. In the first place, I am inclined to think that the universities are becoming more practical; and in the second place I think the scientific schools are becoming more scientific. If these two movements are kept up long enough, the two types of institutions are bound to come together. You will find in the scientific subjects, particularly in the subjects especially taught in the scientific schools, that the professors are doing the same kind of work in general that the professors in the universities are doing. They are doing work that is not useful, if I may be allowed to comment upon the work of some of my colleagues in the scientific schools, not useful in the sense in which the word is ordinarily used, but highly useful if looked

at from a higher point of view. And such work which is now playing an important part in the polytechnic schools of Germany is coming to play a more and more important part in the schools of applied science. The result is that the work of the polytechnic and scientific schools, especially in chemistry and physics, is of about the same order as in the universities. We find, in Germany especially, that the professors in these subjects are interchangeable. The professors of polytechnic schools are being called to universities, and sometimes calls are given in the opposite direction. The same man answers for either position, showing that the character of work done in some subjects in the two classes of schools is about the same.

I want you to note this tendency on the part of these two types of institutions to come closer and closer together. What will happen in the future it is impossible to say. That we shall always have to deal with the applications of science, that these will always be of great importance to mankind, is certain. Some doubt the value of the ideal, of that which is not useful, of the search after truth without reference to its practical uses. But no one doubts the value of the applications of science. The material progress of mankind bears constant testimony to the value of this kind of work. Among the schools that are engaged in it we all know that your school, Case School of Applied Science—an excellent name, by the way,—"School of Applied Science"—that this school is doing its part nobly, and as a representative of the universities, speaking in their behalf, I express the hope that under the guidance of your new President this school may go on to still greater usefulness, and become even more famous than it now is. (Applause.)

SHALL ENGINEERING BELONG TO THE LIBERAL PROFESSIONS?

ADDRESS ON BEHALF OF THE TECHNICAL SCHOOLS, BY PRESIDENT HENRY SMITH PRITCHETT OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Let me convey to you at this auspicious moment of the history of your School the message of good will of the Institution of Technology. All institutions today are more knit together than ever before by bonds of common sympathy and common aspirations. In your growth and in your success, we of the Institute of Technology recognize a larger service to the same country and the same cause which we serve.

We congratulate you in the choice of a leader, who brings to your service strength and courage and knowledge, for however the world may progress, how farsoever institutions may perfect their organization, there will never be less need of efficient leadership. Institutions do not lead; men lead. We congratulate you on the man whom you have called.

Let me say, too, one word of greeting on the part of the American Association for the Advancement of Science, whose President, Dr. Carroll D. Wright, is unable to be with you today, and who has been good enough to ask me to represent him and the Association on this occasion. It is fit that the largest and most representative of American Scientific Societies should send its greetings to an American School of Applied Science, if for no other reason, to remind you that the ultimate purpose of science no less than the ultimate purpose of law, or of medicine, or of religion, is to contribute to the happiness and comfort and spiritual progress of man. We endow the older professions of the law, of medicine, of theology with the possession of a certain altruistic attitude toward mankind. Is there any reason why the Engineer should not have a similar ideal? And if this altruistic motive does not find a place in the ideal of the

Engineer, is it not probable that his profession will lack something of the power of all liberal professions?

The Engineer, in the true sense, is a solver of practical problems. To fit him for this he needs technical knowledge and usually a formal technical training; but the real test of his ability as an engineer is found in the success with which he attacks engineering problems, judging that success by the needs of the problem and the circumstances which surround it. A solution which has no regard to environment and cost is not a real solution.

I remember, years ago, on one of the railroads leading out of St. Louis, an old superintendent of track who was an engineer in this sense. He was hard handed, hard headed, had grown up on the road and lacked formal training, but he had a marvelous power of adapting the means at hand to the solution of the problem set before him. On one occasion, a bridge had been washed away on the main line. It was at a time when traffic was heavy. The general manager strained every nerve, particularly the nerves of other people, to repair the damage. A force of men was hurried to the spot, the division engineer—a newly imported college graduate—set up a drafting office in the adjoining station, and every effort was made to get trains running at the earliest possible moment. Three days after the accident, the general manager came down to the scene of work, in his private car. Dismounting a few hundred yards from the bridge, he walked down the track in the early morning, and the first man he met was the old superintendent of track. "John," said he, "this bridge must be got up at the earliest moment. Have you seen the engineer and got his drawings for the new structure?" "Colonel," said the old man (and I have noticed that all railway managers are colonels—whether born so or made colonels when they are made railway managers, I do not know), "Colonel," said the old track man, "I do not know whether the engineer has got the picture drawed yet or not, but the bridge is up and the trains are passing." In this case the real engineer was he who solved the problem adequately, successfully, efficiently, with the means in hand.

If this view of the engineering profession be granted, it goes without saying that the engineer must be a specialist. The tools with which he works are too vast and too complicated to be learned without special training and special study. Whether he begin that training in the school of engineering or whether he begin it in the harder school of experience, he must acquire the technique of his profession. The question I wish to ask—and it is a particularly interesting question at this phase of our national development—is, shall the engineer, specialist though he must be, belong also to the ranks of the liberally educated?

Perhaps it is not so easy to say what constitutes a liberal education, because education consists of so many factors drawn from so many sources; but a liberal profession is one in which those belonging to it know enough of outside professions and of general human knowledge to respect and to appreciate the work of other men, and the practical question in the education of the engineer is, shall he have such an education as will give him this respect for and this appreciation of other professions and of other men?

It seems to me worth while calling attention to this matter, on such an occasion as this and at such a time, for two reasons. First of all, the demands upon the engineer today are very different from those of twenty years ago, not only on the technical side, but also upon the side of the greater appreciation of other men's work and other men's professions. The engineer today is no longer a mere specialist; he is also the executive officer, the manager, the agent, the director of great business enterprises. And secondly, the inquiry is made at this moment because, in the enormous development of engineering in the last fifteen years, our engineering schools have been under the pressure of trying to deal, in a limited time, with a constantly growing number of subjects, and under this pressure there is felt everywhere a disposition to omit from the engineering courses of our schools and colleges whatever does not minister directly to the technique of the profession.

The boy who comes up from the high school to enter the college or the technical school, whether he is to be lawyer or

doctor or preacher or engineer, is, on the average, about nineteen years old. If he aspires to any one of the three first named professions, he expects to spend from three to four years in college, and then again from three to four years in his professional school. He begins his profession at the age of twenty-six or twenty-eight years, and after an education which is intended not only to fit him as a specialist but to fit him for membership in a liberal profession. The engineer, on the contrary, as a rule expects, within the four years succeeding his nineteenth birthday, to obtain the rudiments of a general education and the training for his engineering specialty. He enters his profession at the age of twenty-three or twenty-four, some three or four years younger than the lawyer or the doctor or the preacher. He has the advantage of going into the world at a time when he is more resilient and quicker to learn, and he has three years the start of the doctor in the practice of his profession. But will the engineering profession, under such a system of education, continue to be one of the liberal professions? Will the members of it have that touch with men of other professions, that respect for their work, which liberally educated men ought to have, and without which a profession, however highly trained, ceases to exercise that moral and social influence which an educated body of men ought to have? Isolation in this world, whether it be of men or of professions, means loss of moral power and decrease in moral and intellectual influence.

It is true, as every one knows, that a growing number of men are coming into the engineering school, after graduation in the college, and it is worth while to note that these men find the work of the engineering school no less worthy of their metal than the work of the medical school or of the law school. But it is also true that this number bears a small proportion to the great rank of men in the profession, and will always do so until, in a few of the leading schools at least, there is demanded a preparation similar to that asked for in the other liberal professions.

It is also worth remembering that on the Continent of Europe the requirements for the education of the engineer are quite similar to those expected of other liberal professions. The

man who enters the German technical school has received an education, somewhat different to be sure from that of the man who enters the university, but one quite as broadening in its influence and requiring quite as long a time for its acquisition. Forty years ago, or such a matter, when we began the building up of engineering schools in this country, it was in response to a pressing demand for engineers. Immediately after the war engineering schools broke out at a dozen different points. We were developing a new country at an unprecedented rate, and in a way never before attempted. A people who for four years had given all their energies to war, suddenly turned them with a similar enthusiasm to the physical development of the country, and schools were adapted to answer this demand as rapidly as possible. That day has in a measure passed by. There is time now to consider the plans for preparing the engineer, not only from the utilitarian but from the educational standpoint as well.

This occasion is not the fitting one for the discussion of such a question. When we meet at such a gathering it is rather to take a general survey of the field, than to map out its details. I can do no more than suggest the inquiry which confronts us, and to call attention to the fact that it does actually confront us.

The inquiry presents itself to my mind in somewhat the following form. During the forty years in which our engineering courses have been developed, there has been an enormous differentiation of engineering theory and practice. Under this process the pressure to make instruction in the engineering school more and more technical has grown constantly greater, and there has been the inevitable tendency to reduce the amount of time given to general subjects, as english, economics, modern languages and literature. The tendency of such a development is to make the engineering school contribute to instruction rather than to education and its outcome is toward a profession more technical and less liberal. It is clearly becoming more and more difficult to give to a student in four years the elements of a liberal education and the technical training of the specialist. If the ideal of the liberal education is to be preserved to the en-

gineer, it seems to me that either the technical school must lengthen its term of study or some friendly compromise with the college must be made, under which the engineering student may obtain in it the preparation in general education without too great an expenditure of time, and thus leave the technical school free to deal with the education of the engineer from the purely professional standpoint.

We are standing today at one of the important epochs in our educational history, and my purpose is not so much to indicate a solution of this question, as to point out the fact that the question actually confronts us, and to urge that we take up in the most serious and reasonable spirit the inquiry how to educate the engineer, with a view of giving him the maximum efficiency as an expert, while preserving to him the fundamental qualities of the liberally educated man.

It seems to me that here in the Case School you have a unique opportunity to contribute to this solution. Here side by side on the same campus stand an Engineering School and a University, each under its own board of control; each sympathizing as the spirit and needs of the time may require, and yet so actuated by ties of daily life and friendly association as to make possible an unusual coöperation in a difficult and far-reaching problem. Let me suggest that the Case School of Applied Science and the Western Reserve University can serve no higher purpose in education than by a friendly coöperation in solving the question, "How should the Engineer be educated so as to give him the highest value as a solver of practical problems and to make him at the same time the member of a liberal profession?"

ADDRESS ON BEHALF OF THE TECHNICAL SOCIETIES.

BY MR. JOHN R. FREEMAN,* VICE-PRESIDENT OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Mr. President:

As a delegate on behalf of our Engineering Societies, I must explain that these also are Schools of Applied Science. They are the more attractive to students, in that they hold no examinations; all studies are elective and voluntary; one recites only when he feels like it; and the social element is preëminent.

Into this university of the Engineering Societies we hope to receive all of your graduates and to retain them as fellow-students and warm friends to the end of their lives.

APPRECIATION OF THE TECHNICAL SCHOOL

In speaking on behalf of the engineering profession, my first words must acknowledge our great debt to the technical school and that this debt is increasing from year to year. Our members are coming to be recruited in an ever increasing proportion from the technical graduates.

From the researches conducted in your laboratories, we obtain much of our most valuable engineering data.

Our best books of reference for the practicing engineer are nearly all prepared by the professors in these technical schools.

The strongest foundation for a country's future industrial and commercial welfare is to be found in Schools of Applied Science, well equipped, guided by men of broad mental horizon. This is scantily appreciated as yet by the mass of strenuous Americans, but has long been clearly seen by the Germans, and is beginning to be seen by the English.

The cost of duplicating the land, buildings, equipment and the endowment of the largest and most complete technical

*Delegate representing the American Society of Mechanical Engineers and the Association of Engineering Societies.

school in the United States is only about half the cost of one of the latest battleships, and the running expenses per year of a technical school training 1,500 young men are about the same at those for keeping a single battleship in commission. The Technical School has a use no less important than the battleship in the "first line of National defence."

In the re-awakening of the old spirit of commercial adventure in foreign lands, we must today base our hope of success on superior excellence and economy of manufacture and in the calling of our engineers to foreign lands.

The growth of our cities is laying a burden of new and larger problems on our departments of public works, a burden which only those trained in the Schools of Applied Science can carry wisely and well.

The business man when he comes to see these matters clearly will urge again and again a generous support to Schools of Applied Science by city, state and nation when private munificence falls short.

These schools need, as managers, the strongest men that can be found, the men of broadest horizon, the men that can arouse the noble ambitions of young men toward advancing the state of an art and that can impart the spirit of joy in work.

APPRECIATION OF THE TECHNICAL GRADUATE

For twenty-five years I have been observing the increasing respect paid by our industrial leaders to the training gained in the technical school. The technical graduate himself has come to better understand his own limitations, and his need of a course outside, under instruction from the foreman and the mechanic. The man of business is coming to understand that there are "firsts," "seconds" and "thirds" produced, that some excel in judgment and some in skill, and that it is not the mere fact of being a technical graduate that brings success, but that given inborn executive ability, the training of college or technical school gives to its graduate a tremendous advantage over the man of equal native force who has not this training.

Twenty-eight years ago the finding of openings by my own

fellow graduates was difficult and slow,—not a third of our men found openings of fair promise within the first six months; the average "captain of industry" did not then know just what a technical graduate was, or what he was good for.

We then listened to prophecies that the annual output of engineering graduates would soon overstock the market. Today, notwithstanding that during the past quarter of a century technical schools have multiplied on every side and that classes in many of the older ones have increased fourfold, the output is quickly absorbed. The department head in one of our largest technical schools has told me repeatedly that in each recent year he has applications from managers of important works for double the number of his graduates, and it is said that certain large and progressive concerns send an agent around the schools in January to select from the brightest of those who are to graduate in June.

The mere register of the occupation of the graduates from any leading School of Applied Science is a most eloquent commentary on the commanding influence of these schools.

Twenty-five years ago among managers of works I heard much about the good *practical* man and his superiority to the theoretical college graduate; today it is coming to be generally recognized that the *good* practical man is the one who has graduated from a technical school and who has then been seasoned by a few years of experience in bumping against the hard corners of construction, and the technical graduate of proved business ability is in special demand.

The Technical School, the School of Mechanic Arts, and the Mechanics Correspondence School, each has its special and distinct value in our industrial life. We should make the technical school attractive to the brightest minds and should look to it for our industrial and commercial leaders, and for the best custodians of the public health, of our water supplies and other public works.

In order to get the most out of the existing technical schools let us keep in mind the limitations within which they can do their most efficient work, and the fact that not every kind of

work will be best done by a technical graduate. The students found without promise of final success should in all kindness be allowed to depart and not hold back the rest.

Doubtless a man may give lines and grades as well, may drive an engine or detail steel work better, if his four years of early manhood have been spent gaining this dexterity and skill outside the technical school. The late Col. T. J. Borden, a sympathetic, thoughtful man of forty years' experience as manager of large industrial works, and himself a technical graduate, told me that for many years he had been observing that a faithful uneducated laborer would in general keep a more correct tally sheet of the unloading of a cargo than the bright high school graduate whose thoughts were flying off to other things; that a large factory engine would be run with better attention and fewer breakdowns by a graduated stoker or oiler than by an expert machinist, who was liable to be scheming out improvements and to have his mind busy with something other than the mere operation of this machine; that often the best routine work was done by a man who was not capable of anything very much better.

The young man who is to follow a narrow routine through life will not have much added to his efficiency as a machine, by the long elaborate course of the technical school. For those constitutionally deficient in ambition, or for those unfortunates who can never comprehend the art of getting on in the world, these four extra years are illspent at school, but there are plenty of young men for whom this training of the technical school is the best possible training and there is plenty of opportunity for a larger number of these men than all of our present schools can graduate.

Men cannot be shaped on the interchangeable system of American Machine Shop,—each will be a "special" and, as already remarked, there will be produced "firsts," "seconds" and "thirds," but fortunately the demand for all types and grades exceeds the possible supply for years to come.

Among the graduates some will possess that rare faculty for which "initiative" is the phrase of the day, and among these

there will be some who will possess that quality of balance and judgment, and attain such knowledge of men, that they will become great leaders, the captains, will establish their own industrial works, or be called to the $10,000 positions which are always so hard to fill right. Others, without this business insight, but perhaps more learned and more skillful in engineering, will design machines and bridges, supervise factories, become the lieutenants and fill the $4,000 and the $2,000 positions, and a still larger number will do noble work as the sergeants, corporals and privates and be made better men by the broadening of their minds in their college course.

The training of no school can make the square peg fit easy in the round hole, and, out of a hundred boys, but few are born with the ear of a musician or the eye of an artist, or with the observing, inquiring, ingenious, imaginative mind, which schools can stimulate but cannot create, and without which conspicuous success in constructive engineering is impossible. But for the young man so fitted by nature, a technical school of broad scope and high aim is a royal road.

A ROYAL ROAD

The old statement that "There is no royal road to learning" is untrue. The man of affairs has come to understand that *the technical school is a royal road to learning*,—a shorter road, an easier road, through a more beautiful landscape, and in equal time attaining a broader outlook.

A man with the earnestness and patience of John Brashier, the strong purpose of John C. Hoadley, the rugged common sense of Edwin Reynolds, the strong, kindly heart and quick intelligence of John Fritz, or the genius of Edison, may reach an equal height by a longer and more arduous road and, like the athlete, increase his strength and harden his endurance in the greater effort, but the royal road of the technical school, in its four years, may from its small group, gathered part by chance and part by process of natural selection from more than ten thousand school boys, bring perhaps ten to the point that otherwise not more than one or two or three could hope to reach in twice these four years.

The technical school is not exclusively for the brilliant man. Much of the world's best work is done by the man of slow moving intellect, to whom the good Lord has given the greater treasure of persistence, of steadfastness, with enough imagination or instinct to feel what is concealed within the cloud on yonder difficult and distant hill.

There is danger in relying upon lectures and reading for teaching and upon written examinations for measuring up a student and his fitness to continue on his four years' course, and one of the greatest advantages of the technical school is found in its laboratory method, for the reason that the personal, individual contact with the student daily in the laboratory gives an opportunity for helping the one who is slow to develop himself.

I have had perhaps twenty graduates tell me in familiar talk that the most helpful man to them of all the technology professors was the lamented Holman. Why? First, because he was intellectually a great and noble man, and second, because he took pains to get acquainted with them and their individual needs *in the laboratory.*

The ablest professors in the staff should be brought into earliest possible contact with the freshman in the laboratory.

THE OPPORTUNITY FOR THE TECHNICAL GRADUATE

For a few moments past we have been considering the broader appreciation by men of affairs for the work of the technical school; let us for a moment review the causes of its great opportunity.

That the manufacture of power was the mainspring of the onward movement of the nineteenth century was made plain, perhaps more lucidly than ever before, by that great engineer, whose recent loss we mourn, George H. Morison, in his Phi Beta Kappa address at Harvard in 1895.

In the skillful application of manufactured power lies the great opportunity of the engineer.

The distribution and use of manufactured power are increasing by leaps and bounds in a way that few of us can see in perspective.

It moves a thousand cotton spindles guided by a single hand, with the power of more than a thousand horses it draws your 20th century express, large cotton factories in Montreal are driven by a waterfall nearly a hundred miles away, the power of Niagara rends the strongest chemical affinities. The chariot, as made in Cleveland, is horseless, but it is propelled by the power of 24 horses, all generated in a little space, and derived from a harnessed explosion. In another part of your city, the most delicate and accurate engraving that the skill of the world has known, an astronomers' circle with markings correct within less than a second of an arc, may go on in solitude as a result of a laborer shoveling coal under a steam boiler. Our early manufacturer sought the power of great rivers. Today there is far more steam power used in Lowell than water power, and in your city of Cleveland, the power manufactured from coal far exceeds that of the greatest single development of water power in the world, Niagara not excepted. The General Electric Co. had on its books on January 31, 1904, undelivered orders for steam turbines of an aggregate power of three hundred and fifty thousand horse power, an amount nearly three times as great as the present total generation of power from Niagara and nearly half as great as the total water and steam power combined, in the six New England States, found in the census of 1880.

With the aid of unlimited power, work is performed in a larger way and with greater rush, and with this comes the greater need of executive ability, of captains and corporals of systematic, observing habit, equipped with the tools and training of the technical school.

This is a transition period and never was there such opportunity for the trained engineer. Mechanical production must supply the natural increase due to the growth in population and replace machines worn out by service and must replace even new machines by something newer. Here in Cleveland, your horse cars were not worn out when the cable car replaced them, your cable railways were not worn out when

the electric car came in. Not only the equipment but the shop that makes it must largely go into scrap.

Two or three years ago, one of the leading engine builders of the world began on new shops in a city on the Great Lakes, the largest of their kind, designed for building engines of the most massive type. Hundreds of thousands of dollars were expended on these shops and their heavy machine tools, but before these shops were occupied customers were inquiring not for engines but for steam turbines.

The leading pump builder of America began two years ago on new shops near New York, these also to be the largest in the world; the plans had been matured by years of study, for building pumping engines of the ordinary reciprocating type. Before these shops are ready for occupancy, the old and simple and inefficient type of centrifugal pump is suddenly so improved as to threaten a revolution which may profoundly change the type of shop equipment demanded.

A maker of valves and fittings, a concern which had kept steadily up-to-date for more than a quarter of a century, started about two years ago to supply its expanding trade by a factory on the shores of Long Island Sound, designed to employ at first 2,000 and later 4,000 men. The plans were matured with rare care and judgment. First, their man of greatest skill in shop methods plans for his various machines and lays out his floor space. Next the skilled mill engineer makes plans to house that floor space in. Next an architect of national reputation for his inborn sense of beautiful form and graceful line, models the outlines of exterior wall and windows and roof. Machine tools of latest design had been purchased, apparently everything had been provided for, when, just as the roofs are on, the successful demonstration of a new kind of tool steel, which permits of far deeper and more rapid cuts, calls a halt and requires radical change.

All this is recent and the end is not in sight.

Not long ago I had a letter from a fine old gentleman of Boston, himself in his day and generation probably the best educated engineer in America—and whose engineering work

began under the great Stephenson on the construction of the earliest steam railroad of the world, in which letter that man who had seen the railroad born, and the telegraph and the electrical powers and a thousand other engineering marvels, spoke of the broader opportunity of discovery for the engineers of today!

Seventy-five years ago when Cleveland was a frontier village, within the memory of a few men now living, the dry dock in the Boston Navy Yard was the most monumental piece of engineering construction and the greatest single work of internal improvement yet completed within the United States, and the total manufactured power in the United States did not exceed the output of one of the large power stations of today.

It is only forty years since the first distinctive general School of Applied Science or Institute of Technology in this country began after years of patient explanation and pleading, by that lovable, eloquent, prophetic, noble man of science, William Barton Rogers, and how profoundly it has influenced the whole course of higher education.

Although the lines of work formerly recognized as engineering may be crowded, there are on every side unworked fields in which the trained engineer possessing business ability, be he builder, sanitarian, chemist, machinist, or electrician, can introduce system, discover causes, lessen cost and improve the product and find for himself a competency and joy in work.

What we need especially in the output from the technical schools is young men who have the ability to handle men, who know something of human nature as well as the nature of the other materials of engineering.

A PLEA FOR THE BREADTH OF CULTURE IN THE SCHOOL

The other speakers today are presidents of colleges, educators of wide experience and national reputation, and it savors of rashness for me in their presence to venture opinions upon the aims and methods of a technical school; but during my twenty-five years of taking on technical graduates in almost every year and trying through them to keep in touch with the schools,

I have often found what has seemed to me a misapprehension among students, friends and patrons of technical schools, that to an audience of friends and patrons a few words from the standpoint of a business man and practicing engineer may have some interest.

Why do we not find the greatest prizes of the industrial works and of civic administration going *more* often to the technical graduate? Why does the commercial department pay better salaries than the engineering department? We have all seen plenty of examples that prove that technical training is of itself an aid rather than a bar to commercial success.

Have our men got too narrow a training in the Technical School?

Within the past week I have chanced to hear two heads of great concerns each employing many scientific men, say in substance that the old academic education fits better for the position where one deals with men, or for the $10,000 position, while the technical school fits better for the position that deals with materials or for the $4,000 position, and I note that sons of my old classmates are being sent first to Harvard or Yale or Dartmouth for *four* years and then to "Technology" for a *two* years' course in science.

Six years time,—from 18 to 24,—is more than the average young man can afford to spend at school. It brings him into the works too late. When we more fully appreciate that *education, rather than information,* is the true aim of the technical school, then a broad education and sufficient information can both be given in a four years' course.

Can we not give a better education to the great majority of our students and plant in them thirst for information by doing fewer things more profoundly and putting more emphasis on the personal element?

Is not the one great captain of science or industry like Pasteur, Kelvin, Ericsson, Bessemer, Westinghouse, Mills, Brush, or Alexander Brown, and a hundred others, worth more to his country and his neighborhood than a room-full of the

very necessary and useful sergeants and corporals of science and industry?

Cannot our school do the most good and best serve all, and best stimulate the ambition of all, by trying to fit men for the position of captains; and if the man skilled in the applications of science,—has also executive skill and such knowledge of men that he can negotiate, convince and arouse men, will not he have a wider opportunity to do good and to advance the state of that art and the public welfare; and shall we not by addressing our teaching to the highest grade thus produce more of the $10,000 men and at the same time better $4,000 men?

In separating students into many courses, is there not danger of splitting things too fine? Have we not gone too far in specializing for the undergraduate?

It is a matter of slight importance to the machine builder whether he takes the course in Mechanical Engineering, Civil Engineering, or general physics, if he is fortunate in his teacher.

The chief function of the Technical School is not the filling of a man's memory with formulas and with knowledge of how everything is made, but rather is the training in methods of thoughtful research, of teaching how to put the question and where and how to find the answer, of how to set traps for his own unconscious errors, how to save time by understanding just what degree of precision is necessary to the case in hand, how to measure with certainty the limits of the ever-present error and above all to develop and strengthen a warm, enthusiastic, undeviating love for the truth.

In my own college days, I did not have it made plain, and I failed to grasp the fact that perhaps the greatest opportunity of college life is that of coming to better know one's fellowmen, and it is in failure to appreciate this more than in any other one feature that the professional school has failed in comparison with the older colleges. In the protest against the old education, exemplified in the early development of the Massachusetts Institute of Technology and other similar schools, the pendulum swung beyond the center and the value of the social idea was for a time not appreciated, and to many of us there

was lost the inspiration and broadening, the deeper understanding of humanity that may come from entering into the daily life of the ancient civilizations enough to understand that human nature is much the same through three thousand years. We missed that focusing and sharpening of the wits which comes from taking time for the discussion of current events with our fellows.

One of our professors read to his class Holmes' verses on the Deacon's Masterpiece, "equally strong in every part," as typifying the ideal machine. McAndrew's hymn may teach a deeper lesson. The young man should be led to find inspiration in his machinery, while in the Technical School.

A few weeks ago in Chicago, I sat beside a classmate, a former "grind," now a successful man of business, at a gathering of the graduates of one of our largest technical schools. Said he,—"We were brought up wrong in being taught to spend so much time on our studies; we practiced a false economy in being too thrifty in our earlier years." We were too late in learning that opportunity, sustaining power and a stimulus toward success come more from a wise good-fellowship than from high scholarship, and that the art of being what in your terse western phrase is called "a good mixer" was an art well worth time, money and paternal advice to cultivate. It is by giving the technical graduate a wise start in this direction that he will ultimately come more often into the larger opportunity and higher salary of the commercial end.

This social feature is, in the final analysis, the chief value of the engineering societies. Although papers are presented in which one engineer so presents his experience that a hundred others may find each his own course more clear in attacking a similar problem and although one may hear presented in an evening hour the results of experiments and research that have cost a year of toil, all so summed up in a few lines of formulas or constants, that a repetition of this labor and expense is saved to all who follow, and although the master mind may publish in the transactions a study upon difficult and disputed points that will lighten labor or save mistakes to many of his fellows; yet,

after all, the preëminent usefulness of the Society of Engineers is in the bringing of men into personal relation, inspiring the young man by personal contact with the man who has done things, giving the older man a chance to size up the growing young men; and, among equals it removes the bitterness to personally know our successful competitor and to know that he is a good, honest man.

If it be asked what suggestions can be offered to his friend the teacher by a practicing engineer, who for twenty-five years has enjoyed taking "green graduates" and trying to help them on their post-graduate course, I venture the following: Dwell on the principles of research, fill the student mind with a comprehension that the school is not so much for filling his memory with information as for teaching the scientific method. Give more attention to the principles of writing reports in clear, exact and vigorous English, to measuring the exact meaning into every sentence. Teach what may be called "commercial rhetoric," bringing the result quickly into the view of the busy man and seeking to so arouse his interest in the opening paragraphs that he will continue reading instead of laying it aside for the leisure hours that may never come.

Emphasize the need, in the practical world, of "getting there" on time. Recognize that a judicious "cramming" for examination is legitimate and that how to do it with the least internal friction is a most worthy subject of instruction. In closing business contracts and in expert work it is a much practiced and most useful art. Direct attention to the conditions necessary for obtaining a maximum output from the human machine. How seldom a man gives to his own body the same care that he would give to that of a $1,000 horse! Long hours under stress in an emergency are easy if the man knows how to avoid fatigue through variety, and has the will power to practice what he knows.

Probably there is no better way to save time and to cultivate judgment than by practice in quick estimates between limits. What does that stone weigh? Not more than 6 tons, not

less than 4. What will that casting cost? Not less than $50, not more than $100. If the owner asks the cost of repairing the tangled smash-up of ten minutes ago, the young engineer can give him almost instantly an estimate that may serve his purpose and be correct if he states it between limits as not more than $10,000 and not less than $1,000; twenty-four hours later he may be able to state it as not more than $5,000 and not less than $4,000.

Urge upon your colleagues the fact that they owe it to their fellow citizens and to the loyal intelligent public that supports the school to promptly and continually translate the story of the latest discovery of abstruse science down to the understanding of the well-educated non-technical man.

Stimulate the interest of the students by continually bringing before them the results of the latest research and of what is being found out in other departments of the school.

Recognize the fact that these four years' time with their attendant expenses are too valuable to be devoted to the attainment of mere manual dexterity. This can be more cheaply learned in the field or workshop than in the school. Do not shrink from turning out graduates who will be strong on theory, while perhaps weak on practice. They can get their practice outside after graduation, and perhaps under the quickening influence of some short-lived ridicule by the routine workman, but the sound foundation of mathematics, the facility in handling and transforming difficult equations, the mental grasp of difficult consideration so as to state them in the language of mathematics and quantity, must be acquired in the Technical School or the chances are that they will never be acquired.

Finally, to the many students here I can bring back no better word from out the years since I left similar pleasant places than to remind you how largely the success of a school depends on atmosphere and that every man has a share in forming public opinion, and to urge you to fill the student atmosphere with the warm fraternal spirit and with ideality—ideality!—with the love of thoroughness, and with reverence for character.

ADDRESS ON BEHALF OF THE COLLEGES OF OHIO

BY PRESIDENT CHARLES FRANKLIN THWING OF THE WESTERN RESERVE UNIVERSITY

Mr. Chairman, Mr. President, Ladies and Gentlemen:

Fifteen years ago, Mr. President, after a service of six years in a neighboring college, you came to Cleveland. A little more than thirteen years ago I also came to Cleveland—to work by your side, in a sense to work with you. In this time the colleges of Ohio have largely changed their presidents and their faculties. Our near college, Oberlin, has seen Fairchild and Ballantine and Barrows go; Buchtel has lost her Cone; Baldwin her Stubbs, and others. The Ohio State University at Columbus misses Scott and Canfield; Denison, Purington; and Kenyon, Bodine and Sterling. I might continue the list, for apparently the days of a college president are few and—I will not say the other epithet,—glorious.

I see before me presidents of some distant colleges, of states from Wisconsin and Missouri to New York and Maryland, each of whom I think, with scarcely an exception, has come to his place since you and I, Mr. President, began to work together. In Ohio is only one college president who is older than I am, and he is now in Los Angeles, and I am afraid he will come back, not wearing a scholar's cap, but a bishop's mitre. So there is a welcome in my heart for you because of the continuity that belongs to me in this glorious and happy service. My welcome for you is a welcome based upon the well assured hope that by reason of proved and acceptable service in this place as the head of an important department you will continue in a yet longer service as the head of all departments.

My welcome is not merely one based upon time, but also based upon the character of the work into which you are en-

tering. You are the President of a School of Applied Science. In Ohio we have two only well equipped schools of science. How many colleges we have, and especially universities, I don't know. If you were becoming president of a new college I might possibly by some ingenuity find some fit word of welcome, but because you are becoming president of one of the two well equipped schools of science in this State I have a very special welcome for you: for the need is of largeness in endowment of every sort in our technical schools.

The school at Columbus and the school in Cleveland are to be made larger, more manifold, and more efficient in condition and force. There is no heart, sir, outside of your own and the official circle, that is more glad than mine for the great and noble gift of Mr. John D. Rockefeller.

Furthermore, I wish to give you a welcome not because of your work and because of its hopefulness of long service, but also because of a relation yet more personal. The Case School of Applied Science and a department of Western Reserve University are placed side by side, upon the same campus; an indivisible and invisible line divides the common field. The opportunity is as unique as it is rich for building up a combined course of work that shall represent the basis of the liberal learning and the efficiency of the technical school. Our work is the work of association in place. I might also say it is the work of association in time. Almost in the same year these two institutions, born of generous hearts and high purposes, came into being, and our reasonable hope is that for numberless centuries they are to coöperate.

We have also a common association in the service of a common trusteeship. There are in this university and technical school three corporations. One trustee is a member of three boards, and many are members of two. What interests and profits one interests and profits the others. Furthermore, in a very distinct and personal way you and I, President Howe, are associates, having with our colleagues worked out a course which, in the opinion of some, represents an efficient and useful method for making liberally trained men efficient and efficient

men liberal in this connection. Because of this common association in work, service, and personality, I have a very hearty welcome.

Yet there is a welcome that lies a bit nearer and dearer to one's heart; that is the welcome born of good fellowship and esteem. Every morning as I sit at my desk I see President Howe coming to his work through that beautiful campus. His head is lifted as if he were trying to search for those stars lost in the morning light. But I know his footsteps and his heart are bearing toward the office where he hopes to meet the boys and his associates. It is because of our common work as two men who care for each other, who are placed in the same conditions, the same environment, one of whom is a good fellow and the other of whom tries to be, that I have a most hearty welcome foı you, my dear friend, to this great opportunity.

INAUGURAL ADDRESS

BY PRESIDENT CHARLES SUMNER HOWE

DOES A TECHNICAL COURSE EDUCATE?

Before we can answer the question "Does a Technical Course Educate?" it is necessary that we understand what education should mean. We do not need to trace this word back to its root, to find its derivation in some ancient language and to learn its exact meaning in that tongue, but rather to find what it has stood for in the thoughts of men, what processes have been necessary to produce it and what its value has been to those possessing it. If we take a brief look at some of the methods and ideals of education in the past we may receive light upon its proper meaning today. Education is for the benefit of the individual or for the benefit of the state. In Persia, in Egypt, in Greece, in Rome, the individual was nothing, the state was everything. The hopes, the desires, the wishes of men were not considered; the growth and prosperity of the state were paramount. In Persia and Sparta education was for war. The education of the body was for the many; the education of the mind for the few. Aristotle was the first to teach that the ultimate end of education is the ability to enjoy the blessings of peace.

Society derives its ideals of education at any epoch from the limits of knowledge at that epoch. A man can teach only what he knows. If he knows but little he can teach but little; if the sum of human knowledge is small, there is but little to be taught, although there is much to learn. In the early days of Greece the Trivium and the Quadrivium embraced all knowledge. Grammar, rhetoric and dialectics were taught to all who entered the schools; arithmetic, geometry, astronomy and music were reserved for the more advanced, who were few in number. The former were language studies; it was understood then as now that language, one's own language, is the most important

subject for the beginner to study. It is a significant fact that the Greeks studied no language but their own. In Rome, too, all knowledge was found in the Trivium. Having little else to study, the Greeks and Romans each built up a language and a literature which have never been surpassed, the former for its scientific accuracy, the latter for the beauty of its thought and the elegance of its diction. The sciences of the Quadrivium were slowly developed by the Greeks, the Romans and the Arabs, and in the case of geometry and music were brought to a high degree of perfection. But science in these early as in later days met with much opposition from those whose chief study was language or philosophy. Socrates believed that the study of science was profitless and wrong, "for he did not think that such matters were discoverable by men, nor did he believe that those acted dutifully towards the gods who searched into things that they did not wish to make known." Locke must have been reading Socrates when two thousand years later in his "Thoughts on Education" he said, "Natural philosophy as a speculative science, I imagine we have none, and perhaps I may think I have reason to say we never shall be able to make a science of it. The works of nature are contrived by a Wisdom and operate by ways too far surpassing our faculties to discover or capacities to conceive, for us ever to be able to reduce them to a science." During the dark ages ignorance and superstition blotted out all education and all desire for education among European peoples, the Moors of Spain alone excepted. Some remnant of learning remained in the monasteries, but it was only enough to accentuate the intellectual darkness which enveloped the nations.

The rise of the mediæval universities marked the revival of learning. In Paris, Oxford, Bologna, Prague, Vienna and many other cities were established great schools of the liberal arts, law, medicine and theology. The Trivium and the Quadrivium were still the principal subjects studied. Learning was surrounded by a high wall and the only entrance to the sacred enclosure was through the Latin gate. All books were in Latin; Latin grammar and rhetoric were first studied. Pupils slowly

repeated grammatical rules recited by the teacher and then learned by rote the works of the classic authors. Dialectics next received attention and pupils spent years in wrangling in Latin over disputed constructions in grammar or knotty points of law and theology. There was no vernacular literature. The lore of the ages had been concentrated in Greece and Rome and, though these countries were now shorn of their ancient splendor, they still dominated the world of learning. This was but natural, as the languages of western Europe were crude and unformed, while the classic tongues were polished and refined. Latin was the language of the educated; a knowledge of it opened the door to all art, literature and science. It was the badge of an aristocracy, a secret brotherhood of learning. Those within the order had certain privileges not possessed by others and they looked down upon those outside their ranks. The education of this period lifted men out of the ignorance in which they had been engulfed for centuries and gave them all the knowledge of the world. This knowledge was centuries old it is true, but it was fresh and new for those who had rediscovered it. They churned it over and over, pressed it into new forms and expressed their wonder and admiration at the beauty they found in it. But as a rule they made no effort to improve upon it, to discover new truths or to impress their own thoughts upon the world. The student who receives all his knowledge in a foreign tongue, different from the language of his every-day life and thought, will seldom add to that knowledge. Truth reveals itself to him who diligently seeks it at all times and places, whose every thought is given to the search and whose mind is open to receive it even when engaged in the most commonplace affairs of life. A man, living in his native country, thinks in his own tongue; if there are no words in that tongue to express the ideas which come to him, they are apt to pass unheeded.

The dawn of the Renaissance brought new factors into the intellectual life of Europe. The several languages settled into fixed forms and became more refined. Reading, writing and arithmetic were taught in the mother tongue and so education

spread among the common people. Scholasticism gave place to classic culture, and the study of history, philosophy and mathematics became more common in the universities. Latin was still the language of learning and the classic authors the chief source of culture. During the centuries which have followed, the changes in methods and subjects have been slow. In the past the teacher has been the most conservative of men. He has taught that which he himself learned and has followed the methods of his teachers. Education has been a rigid mold, a cast-iron form into which all were pressed and came out exactly alike. All culture and the greater part of learning were embalmed in the classic tongues, and these mummified forms were thought to be eternal and unique. But the spirit of scientific inquiry has shattered the mold and one subject after another has been added to the curriculum of the university. Men have come to see that language is a means and not an end; that the true subject for study is not grammar, but the universe. It has taken many centuries to show that education is many-sided and of many forms. Until within a few years the curriculum at each college has been fixed—so much language, so much mathematics, so much philosophy, so much or rather so little science. The student who had no taste for mathematics was forced to do as much as the one whose taste was for formulas and numbers; he who disliked language must cram Latin and Greek for years or he could not be called an educated man. But new ideas and new methods have come within the last half century. It has come to be recognized, the advocates of the new method say, that all men are not alike, that what is suitable to develop the mind of one will not answer for another. Individual tastes and capacities have been at last respected, and no student is now forced to try to become a linguist or a mathematician or a philosopher or a scientist or a weak combination of them all against his wishes. The educational pendulum has swung from the conservative to the radical side and now the student may decide to specialize in chemistry, or logic, or Anglo-Saxon before he knows what these terms mean. In some respects we have reverted to the methods of the mediæval uni-

versities, for now as then a student may graduate without much knowledge of his mother tongue.

Which of the methods so hastily mentioned has produced true education and which results shall we use to settle the question under discussion? Is the true method that of the Chinese which taught a worship of ancestors and a reverence for antiquity; or that of Persia and Sparta which prepared men for war; or that of Athens, which in the words of Milton "taught men to perform justly, skilfully and magnanimously all the offices, both public and private of peace and war;" or that of ancient Greece and Rome which developed an almost perfect language and literature and produced an art and philosophy which have been the admiration of the ages; or that of the mediæval universities which revived a part of the old learning but added nothing new; or that of the centuries succeeding the Renaissance which laid chief stress upon classic culture but developed a vernacular literature and gave birth to the sciences; or that of the present with its tendency to absolute freedom in the choice of studies? Among this diversity of methods and results it is difficult to select a criterion by which to settle our question. Many definitions of an educated man have been given, but among them all I know of none that will appeal to a scientific mind like that of Huxley. He says "That man, I think, has a liberal education, whose body has been so trained in youth that it is the ready servant of his will, and does with ease and pleasure all that, as a mechanism, it is capable of; whose intellect is a clear, cold, logic engine, with all its parts of equal strength and in smooth running order, ready, like a steam engine, to be turned to any kind of work and to spin the gossamers as well as forge the anchors of the mind; whose mind is stored with the knowledge of the great fundamental truths of nature and the laws of her operations; one who, no stunted ascetic, is full of life and fire, but whose passions have been trained to come to heel by a vigorous will, the servant of a tender conscience; one who has learned to love all beauty, whether of nature or of art, to hate all vileness, and to esteem others as himself."

Without attempting to rival this and other definitions, I may say that considering the subject from an intellectual standpoint only, if we are to train educated men I believe we must teach our students to know, to search, to think. To know—what? That is the question which our institutions of learning have been trying for many centuries to solve. When all knowledge was embraced in the Trivium, the problem was easy. He who mastered the Trivium was educated. Now the very extent of knowledge makes the problem difficult. The chemist, the mathematician, the botanist, the philologist each declares that unless a man knows something of his specialty he is not broadly educated. Enough is known in mathematics to keep a student busy for his entire life, and the same is true of all other branches of learning. The poor student is urged by one teacher and conditioned by another, is given lessons by each long enough to consume all of his study hours, and wonders why he is obliged to try to master things he does not like; or turned loose to browse as he pleases, seeks too often the easiest paths and gains but one side of an education. No man can know all there is to know. However great his attainments, however broad his sympathies, however brilliant his intellect, he can only prospect a little on the mountain of knowledge. Is it necessary to know all? Are there not some things, a knowledge of which is necessary in education and others which can be left to the individual taste? I believe that in the future all colleges will answer this question, as some have already done, in the affirmative. Those which still adhere to the required curriculum must permit a certain amount of natural selection, while those which offer almost absolute freedom in choice of studies must place more restrictions upon youthful tastes. And what are these necessary subjects which all should master? First and foremost is one's own langauge. The ability to speak and write the mother tongue should be insisted upon in every scheme of education. It is evident that the secondary schools cannot complete this work. The entrance examination papers in every college show that the students know very little about rhetoric and composition. It is a slow process to teach a student to express himself

clearly, concisely, elegantly. Cato said, "Get a firm grip on the matter and words will follow fast enough." This may have been true two thousand years ago, but either it is not true today or our students do not conform to the condition. The English language should be studied from the time the student enters college until he leaves if he is to be master of his own tongue. Modern languages, two at least, should also be insisted upon. Knowledge is not circumscribed by boundary lines nor learning located by latitude and longitude. No one country, no one language contains all that the educated man should know. The study of literature will naturally be coincident with the study of language. The great thoughts of some of the great men of all ages should be known and understood. The range of reading should be wide, the critical study of style and content be confined to a few authors. History should be included in the list of necessary subjects. The history of one's own country should be well known; the history of other countries restricted to the most important events. Most of our college students have not studied American history since they were in the grammar schools and few if any of our colleges make it a required part of the curriculum. Can any knowledge be more important to the educated man than the history of his own country, and is the amount acquired in the grammar school before he is fourteen years old sufficient? History should not be confined to great events or to the manners and customs of the people, but should include past and present politics. Many years ago there was inscribed upon the walls of the historical rooms of Johns Hopkins University the words of Freeman, "History is past politics; politics is present history." Past and present political parties, the principles they have or do stand for, the success or failure of their policies and their effect upon the welfare of nations may well be required. The study of civil government is closely allied to the preceding. Very few of our college students can describe the government of the cities in which they live or tell the names and functions of the several courts of justice in their native states. Economics, though not a required study in most of our colleges, is one with which all should be familiar. The

functions of land, labor and capital, the relations of labor and capital, the nature of supply and demand, money, production, distribution, wages. rent, taxation, tariff should all be understood. Philosophy and Ethics should, I think, receive a small amount of the time devoted to required studies. Nor can a man be called educated unless he knows something about Art. The several schools of painting and sculpture, the great paintings, the great statues, the masterpieces of architecture should all be familiar to the student. Chemistry and Physics have made the wealth of our modern world, have revolutionized our mode of living, have dictated the policy of nations and have changed the course of history. Yet how few of our institutions of higher learning require either of them except as entrance subjects? There is very little in mathematics which is necessary for the educated man to know. Arithmetic, algebra and geometry are required in the secondary schools and from the standpoint of knowledge nothing else need be required. Botany and astronomy are likewise necessary. The educated man moves among the trees, the plants, the flowers by day and sees above him the planets and constellations by night. No more than in the days of Job may he bind the sweet influences of the Pleiades or loose the bands of Orion, but he should know the north star when he sees it and be able to tell why the Copernican theory is true.

Am I requiring the educated, the broadly educated man to know too much? He can learn something of all these subjects during his college course and yet have a great deal of time left to follow his own individual tastes. The standard by which to judge the technical course, to ascertain its deficiencies, must be broad. In these days of telephones, electric cars, X-rays and the wireless telegraph ought we to call a man educated if he has not given considerable time to the study of Physics? Ought we to call a man educated if he does not know the history of the great political parties and our methods of government? Ought we to call a man educated if he moves among the phenomena of nature by day and by night with no more knowledge of them than if he were blind? And yet we are graduating from our colleges many men who know little or nothing of any

of these subjects and we do call these men educated. The educated man is to live in his own generation; he is a citizen of today, not of yesterday or tomorrow, and he should know those things which will fit him for the business, social and political life of his own time.

To search. However much a man may know, there is yet more to be known. It is not necessary for the educated man to know everything, but it is necessary for him to be able to find anything in the realm of knowledge. He should be taught how to use indexes, dictionaries, encyclopedias and other books of reference; libraries, art galleries and museums should open their stores to him when he bids them. Everyone knows how to look up a word in a dictionary or an article in an encyclopedia, but the systematic use of all sources of information is rarely taught. The student has not been fully initiated into the mysteries of his order until he has been taught to search. Then the freedom of the scholar is his and the universe lays its treasures at his feet.

To think. The most important and the most difficult! Man may be by nature a thinking animal, but if so, he does his utmost to conceal his powers. The faculty of original thought never comes to most men. In childhood we must accept what is told us and we become so accustomed to receiving our ideas from others that many of us never outgrow it. We believe without question what we read in books, magazines and newspapers, what we hear in the class room and from the pulpit and platform. But the broadly educated man must think for himself. The mind, like the body, should be put through certain exercises to gain strength. Mathematics and the ancient languages, which have been omitted from the list of things the educated man should know, are among the most powerful influences for training the mind. This is why they have held such an important place in the curricula of our colleges. But they are not the only subjects which will stimulate mental thought and teach the mind self-reliance. A man may grow strong by rowing, by using chest weights or by chopping wood. Any one of these will stimulate the nervous system, send the

blood to all parts of the body and keep every muscle in a healthy condition. The proper study of chemistry or philosophy or thermo-dynamics will have a like effect upon the mind. But there are many muscles in the body; if a man uses his biceps only, he will not grow strong in the legs. And there are many powers of the mind. If the intellect is to have all its powers of equal strength, as Huxley advises, the man must be taught to think in more than one direction. He must study language, mathematics, science, philosophy, not for knowledge only, but for discipline.

If these requirements, which, I confess, have a large personal equation, are necessary to produce education, does a technical course educate? Perhaps it would be proper first to inquire: Do our colleges and universities educate? Do they teach their students to know, to search, to think? Have they not gone too far in the direction of allowing any man to study anything? But it is the technical school and not the college which is under discussion. The technical school is a professional school and its duty is to train its students for active professional life. It is not a university nor a college. Its aims and its methods are different from either. Its business is to teach, and if it does not teach, it has no excuse for existence. In a university, the faculty are expected to do little teaching and much research work; in a technical school they are expected to do much teaching and little research work. Research and expert work are advisable to a limited extent—limited, however, only by the time and strength the instructor has left after his regular work is done. They should be encouraged by the authorities in every possible way under the above restrictions. Research work is the legitimate outcome of learning to think. He who possesses the power will find ways and means to use it. Coal burned in our furnaces yields but a fraction of its energy in useful work; the sun's rays shining upon the roofs of our manufactories have stored up energy enough to light and heat the buildings and to operate all the machinery within, but we use none of it. Surely there is opportunity for original work by the engineer. The community has a right to demand that

the professor in a technical school shall do expert work. The knowledge he possesses, the laboratories and apparatus at his command, should be for the use of the community whenever this will not interfere with his first duty as a teacher.

Engineering is a learned profession. Schools of law, medicine and theology do not attempt to give a broad education. They either require a liberal training for admission or they admit students from the secondary schools. In both cases the course of study is the same. The engineering student usually comes directly from the secondary school. It would be possible to give him drawing and shopwork at once, to furnish him with tables and empirical formulas and have him begin technical work immediately. But this would make him a mere machine and not an educated engineer. The technical schools recognize that they are training for a learned profession and require the students to give the greater part of their time for two years to liberal studies. The purpose of the Roman schools was utilitarian, but they furnished a sound training. The purpose of the technical schools is likewise utilitarian, but they give a broad and liberal education as far as they go. English is thoroughly taught during the time devoted to it. The training in modern language is good, although its chief aim is to teach the students to read scientific books and periodicals. Mathematics is thoroughly taught; it has to be, for it is the basis of all engineering work. Physics and Chemistry are required to a greater extent than in any college. Economics is required in some and offered as an elective in many others. The technical student is taught to search. Books of reference, periodical literature, proceedings of societies and government reports are made a part of his education. And an effort is made to teach him to think. The connection between theory and practice can be learned only by vigorous mental effort. It is only by right thinking along scientific and mathematical lines that the student learns to transform a theorem into a dynamo or a formula into a compound engine.

And thus I am led to the conclusion that a technical course does educate to a limited extent. It teaches the student

to search and it teaches him to think; it teaches him some of the things that an educated man should know, but it does not teach him all that an educated man should know. It would be much better if our technical graduates were broadly educated men as well as trained engineers, if they had received a college training before entering upon a technical course. In a university it would be easy to require this. Two courses would be open to the student. He could complete his college work with no reference to technical subjects and then enter the engineering department; or after completing those subjects which are considered necessary for a liberal training, he could choose a part or the whole of his electives in the technical school. In the former case his combined college and professional course would require six or seven years; in the latter case five or six years. Some of our universities have such a requirement and I am glad they do. I believe the student should be trained to know, to search, to think before he enters the technical school. During his whole life he would have a broader outlook, a deeper sympathy with men and events, a greater influence upon the community. I am not sure that he would be a better engineer.

But however desirable such a combined course may be, it is not possible at present to make the whole or a part of a college education a requisite for admission to the technical schools. In 1902 there were graduated about 1,600 engineers; there was a demand for about 4,000. If a college diploma were required for admission, the number of graduates would not be more than a quarter as large as now. Even if it were possible to make such a requirement, I do not think it would be wise to do so. Whatever may be our opinion in regard to the best course of study, we must take into account the wishes of the student, and the average technical student does not wish to go to college. He thinks the course of study too long and too expensive. He would be forced to give up all hope of an education if six or seven years were necessary to obtain it. A man's first duty is to make a living for himself and for those dependent upon him. The average boy—your boy and mine—has his own way to make in the world. He will be given an education, but after

that he must take care of himself. The technical course, if understood, is wonderfully attractive to the boy. The Talmud says, "the end of learning is doing;" the end of a technical course is doing, and the average boy wants to do something. He knows he can make a living as soon as he graduates. It is not strange that he wishes to begin this work as early as possible and to finish it as soon as consistent with thorough preparation for professional duties.

In conclusion I would say that the technical school has three great duties to perform in education.

First: To maintain a high standard in its professional teaching. It was created to do this work. Technical training is education of a high order although not liberal. The mistakes of the engineer are destructive to property and sometimes to human life; hence the standard of teaching should be high.

Second: To see that it does not degenerate into a trade school. The student will go into practical work when he graduates and so there is a tendency to give him more and more practical work in the school. There is no objection to this, provided it does not interfere with the broader studies already described. If the liberal studies usually given are dropped, the technical school will become a mere shop or drafting room.

Third and last: To encourage those young men who are planning to enter technical work to first obtain a broad and liberal training to the end that they may be better citizens and wield a greater influence in society, the community and the state.